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REPORT OF THE VACCINATION COMMITTEE.

THE Committee[*] appointed by the Society beg to present their Report on the evidence which the present state of medical knowledge supplies as to the conditions affecting the protection afforded by vaccination against death[†] by small-pox occurring in persons contracting that disease.

In the first instance they desire to cordially thank those medical men who have assisted them to obtain the information upon which this report is based.

The Committee's task has been no easy one, owing to the fact that those engaged in active professional duties are often prevented from recording at the time notes of the kind required by the Committee. They have, however, been fortunate in obtaining from the small-pox hospitals of the Metropolitan Asylums Board at Deptford, Fulham, Homerton, and other sources, the statistics of nearly 10,000 cases,[‡] amongst the largest contributors of this information being Drs. Collie, Gayton, MacCombie, and Sweeting.

The Committee have principally directed their attention to the amount of protection against death by small-pox afforded by infantile vaccination of one and another kind. This part of their investigation they have not extended to ages after 20 years of life. They have also examined the amount of protection afforded by re-vaccination, especially among the attendants upon small-pox patients. Information, too, has been sought as to subsequent attacks of small-pox in the same person, and as to insusceptibility to vaccination, especially as to insusceptibility in the babies of mothers who during the pregnancy have passed through an attack of small-pox. The following questions have been asked:—

I.—What cases of small-pox have come under your observation among children under ten years of age who have been vaccinated in infancy; and, of these, which have died?

Please answer this question by filling up Form A or A 1.

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[*] Dr. Robert Cory, Dr. John MacCombie, and Mr. Shirley Murphy.

[†] The Committee would especially warn the reader that these statistics, with the single exception of the data respecting re-vaccinated persons employed at small-pox hospitals and in attendance on small-pox patients, do not in any sense profess to measure the *liability to attack* by small-pox of any class of persons, whether vaccinated or unvaccinated.

[‡] See foot-note, page 151.

II.—What cases of small-pox at ages from ten to twenty years have come under your observation among those who have been vaccinated in infancy?

Please answer this question by filling up Forms B and B 1.

[It has been found necessary to arrange the forms to suit the convenience of (1) those who have registered the number and quality of vaccination cicatrices, and have omitted to note the superficial area which these cicatrices occupy, as well as (2) those who have recorded the quality of the cicatrices and the area occupied by them, but have omitted to note the numbers of cicatrices; for the former, forms A and B have been prepared, for the latter, A 1 and B 1. In filling up A and B, "good" vaccination includes only those cicatrices which are foveated, and "indifferent" vaccination only those cicatrices which are plain or unfoveated. In filling up A 1 and B 1, "good" vaccination includes only those cases possessing cicatrices which are foveated, and which, together, occupy not less than one-third of a square inch; "indifferent" vaccination includes cases possessing plain or unfoveated cicatrices and foveated cicatrices which, together, occupy less than the above area.]*

III.—What cases of small-pox after re-vaccination have come under your observation?

In answering this question, please state, as far as possible:—

(*a*) The number and character of the primary vaccination cicatrices.

(*b*) The age of the patient at the time of secondary vaccination; the number and character of the resulting cicatrices. If none remain, please state the fact, as well as any fact as to the maturity of the vesicles or intensity of the inflammation.

(*c*) The character of the attack of small-pox, and the result.

(*d*) The age of the patient at the time of the attack of small pox.

(*e*) The sex of the patient.

IV.—(*a*) How many persons have you known to be in personal attendance on cases of small-pox?

(*b*) How many of these had previously had small-pox?

(*c*) How many of these have contracted small-pox?

(*d*) How many of those who did not contract small-pox were re-vaccinated?

(*e*) How many of those who contracted small-pox were re-vaccinated?

Of the last, state the character of, and date of, vaccination; the date, character, and result of attack of small-pox.

V.—How many cases of small-pox have come under your observation in which the patient had previously suffered from this disease?

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* The necessity which the Committee have since found of separating, for the purposes of classification, all cases possessing foveated vaccination scars from those possessing unfoveated scars, has made it impossible for them to use the returns which relate to "area and not quality", and which group under the heading "Indifferent Vaccination" cases with foveated scars, having a combined area of less than one-third of a square inch, with cases possessing plain or unfoveated scars. In reference to number of scars, it is greatly to be regretted, for a reason which will presently appear, that the data supplied to the Committee make no distinction between three *and more than three* scars.

VI.—Have you ever met with a case of insusceptibility to primary vaccination, and if so, how many?

VII.—Have you ever vaccinated any child whose mother suffered from small-pox during the pregnancy, and if so, with what results?

In reference to the protection against death by small-pox afforded by infantile vaccination to persons attacked, subsequently to their vaccination, by that disease, the Committee have, of course, had regard to the fact that the tendency to death on attack by small-pox is not, for unvaccinated persons, the same at all ages. This fact is well illustrated by Dr. Gayton, whose table, showing the fatality of small-pox among admittedly unvaccinated persons attacked by the disease at various periods of life, is here made use of.

Admittedly Unvaccinated Persons.

Age-period, Years.	Admitted.	Died.	Mortality per cent.
0– 5	677	383	56.5
5–10	510	180	35.2
10–15	317	74	23.3
15–20	204	86	42.1
20–25	174	83	47.7
25–30	105	56	53.3

The table shows that of unvaccinated persons attacked by small-pox in the first five years of life, more than half die of the malady. In the next five years (5-10) the small-pox mortality among such persons becomes reduced to little more than a third of those attacked. At the age-period 10-15, liability of unvaccinated persons to die of small-pox, when attacked by the disease, is at its minimum, less than one-fourth dying when thus attacked. But after the age of fifteen years the fatality of small-pox among unvaccinated persons increases, and at middle life one-third to one-half of such persons die if attacked by the disease. Taking the fatality of the disease, as observed among unvaccinated persons by Dr. Gayton, as a standard of comparison,* we have examined the data furnished us in reference to the fatality of the disease at several periods of life up to twenty years, among persons possessing, at the date of their attack by small-pox, "vaccination" of various sorts, and we now state the results of this examination briefly, and as much as possible in tabular form. For convenience we use, in the text, rates of fatality; but in all cases we give in appendix the numbers on which the rates are based. As a result of our division and subdivision of the cases furnished us, some of our data are, it will be observed, of necessity based on small figures only, and accordingly our inferences thereon are, to a certain extent, provisional inferences. We believe, however, that all the indications of this Report will, in the end, be found to be true indications.

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* The Committee regret that the information they have received does not admit of grouping of the cases in every instance into age-periods identical with those of Dr. Gayton's unvaccinated table. The Committee, however, believe that for all practical purposes in relation to what follows the age-periods in each may be regarded as the same.

Dealing broadly with the subject in the first instance, the vaccination of some seven thousand five hundred of the small-pox cases returned to us may be classed roughly under three heads: (*a*) "stated to have been vaccinated but having no cicatrix" (nominal vaccination); (*b*) "vaccinated, and having plain or unfoveated cicatrices" (imperfect vaccination); and (*c*) "vaccinated, and having well foveated cicatrices" (good vaccination).

> The records of appearances of cicatrices are necessarily dependent upon those appearances at the time of attack by small-pox. The Committee recognise that not every cicatrix which is once foveated will always retain its condition of foveation, and, further, that not every cicatrix will permanently exist. The circumstances which give rise to these changes in cicatrices need not be here discussed in detail; it is enough to note that the permanence of vaccination cicatrices and of their foveation is dependent, in the main, on two conditions: namely, on the character of the original vaccination, and on the influence of time as modifying the individual who received it.

Table I(*a*) gives the fatality among small-pox patients under each of these headings at several age-periods up to twenty years, and also the fatality of the disease at corresponding age-periods among patients confessedly unvaccinated.

In Table I(*b*) the fatality among unvaccinated small-pox cases is taken as 100 in each age-period, and the other rates in Table I(*a*) are corrected on this assumption, to enable a comparison to be made between fatality of small-pox among unvaccinated and vaccinated persons respectively.

TABLE I(*a*).

Age-period, Years.	Unvaccinated.	Age-period, Years.	Vaccinated.		
			(*a*) Nominal.	(*b*) Imperfect.	(*c*) Good.
0 5	56.5	0- 5	36.6	11.0	1.5
5 10	35·2	5-10	26.6	5.2	1.5
10-15	23·3	10-14	21.3	3.5	1.1
15-20	42.1	14-20	26.3	6.3	2,6

TABLE I(*b*).

Age-period, Years.	Unvaccinated.	Age-period, Years.	Vaccinated.		
			(*a*) Nominal.	(*b*) Imperfect.	(*c*) Good.
0–5	100	0–5	65	19	2.6
5–10	100	5–10	75	15	4.2
10–15	100	10–14	91	15	4.7
15–20	100	14–20	62	15	6.1

These tables appear to give the following indications:

1. *As to the age-period* 0-5 *years.*—This is the period when small-pox is most fatal to unvaccinated patients, and the period, therefore, when the conflict between vaccination and liability to death from small-pox is keenest.

Nominal (*a*) vaccination at 0-5 years, *i.e.*, vaccination in regard to which no scar is discernible at date of attack by small-pox during this age-period, is a comparatively small protection against death from small-pox; the fatality of the disease in small-pox patients having vaccination of this sort being no less than 65 per cent. of that witnessed in unvaccinated persons of the same age.

It is an interesting question how far a vaccination which, within five years of its performance, has left no scar at all, has been originally an "unsuccessful", or even a sham, vaccination; indeed, whether, in a large proportion of these cases there has been any attempt whatever at vaccination.

Imperfect (*b*) vaccination at 0-5 years, *i.e.*, vaccination in regard of which unfoveated scars are visible at the date of attack by small-pox during this age-period, has the effect of very greatly reducing the fatality of small-pox; the fatality of the disease being, in this class of vaccinated patients, only 19 per cent. of that witnessed in unvaccinated patients of similar age.

The contrast, however, between the protection afforded at 0-5 years by "imperfect" vaccination and by "nominal" vaccination is not without significance as to the real meaning of "nominal" vaccination *at this age.*

Good (*c*) vaccination at 0-5 years, *i.e.*, vaccination in regard of which the scars at the date of attack by small-pox during this age-period are well foveated, is an enormous protection against death by small-pox; the fatality of the disease in this class of vaccinated persons at 0-5 years being but 2.6 per cent. of that witnessed in unvaccinated patients of similar age. Similarly, it is only 4 per cent. of that in class *a* (nominal) vaccination, and not more than 13.6 per cent. of that in class *b* (imperfect) vaccination.

2. *As to the age-period* 5-10 *years.*—That in which the liability to death among unvaccinated small-pox patients is diminishing.

Nominal (*a*) vaccination at the age-period 5-10 years is even less protection against death by small-pox than in the preceding quinquennial period. In unvaccinated persons the fatality is 35.2 per cent. in the age-period 5-10 years, as compared with 56.5 per cent. in the age-period 0-5 years; while, as regards nominal vaccination, the fatality in the age-period 5-10 years is 26.6, as compared with 36.6 in the age-period 0-5 years. Though there is a diminished fatality at 5-10 years as compared with 0-5 years, both in unvaccinated patients and in patients possessing nominal vaccination, the diminution is not equal in the two classes. Indeed, regarding the fatality of unvaccinated patients in each age-period as 100, the fatality of the nominally vaccinated patients is, in the period 0-5 years, 65, and in the period 5-10 years, 75. Such actual diminution of small-pox fatality as is witnessed at 5-10 in nominally vaccinated children, as compared with the same class at 0 5 years, is therefore probably due to the age of the patients alone, and not at all to vaccination; this class, indeed, appears relatively less effectively protected by vaccination against death from small-pox at the age-period 5-10 years than at the age-period 0-5 years.

This fact is consistent with nominal vaccination at 5-10 years having been, so far as it was vaccination at all, altogether perfunctory vaccination.

Imperfect (*b*) vaccination at the age-period 5-10 years. The fatality of small-pox among patients possessing this sort of vaccination at this age-period is but 15 per cent. of that witnessed in unvaccinated patients. In the age-period 0-5 years it is 19 per cent. that of the unvaccinated. At the age-period 5-10 imperfect vaccination is therefore relatively more protective than it was at 0-5 years.

This apparent increase of protective power of imperfect vaccination obviously requires explanation. The influence of time upon the amount of protection afforded by vaccination can only (so far as is known) be to diminish it; there is certainly no known circumstance that can increase it, and the explanation of the above fact is, in all probability, as follows:—It is conceivable that some children, whose vaccination cicatrices in the age-period 0-5 years qualified them for rank in class *c* (good vaccination), would, in course of time, lose this position, owing to changes in the appearance of the cicatrices, so that, at the time of attack by small-pox, they would be grouped by an observer with children whose cicatrices had been throughout of inferior quality, *i.e.*, class *b*, imperfect vaccination The effect of such transfer from class *c* to class *b* would undoubtedly be to add to the latter class persons losing, indeed, their protection, but still fairly well protected against death by small-pox, and in this manner the lessened rate of fatality of small-pox in this class may be accounted for.

Good (*c*) vaccination. The fatality of small-pox among patients in this class at the age-period 5-10 years is 4.2 per cent. of the unvaccinated at the same age-period, whereas during the previous quinquenniad it was 2.6 per cent. that of the unvaccinated. Instead, therefore, of there being, as with the *b* class, a diminution of fatality at 5-10 as compared with the age-period 0-5 years, there is, in *c* class, a decided increase of fatality, and a considerable loss of protection in this class is therefore indicated. Nevertheless, at 5-10, "good" vaccination remains vastly superior to either "nominal" or "imperfect" vaccination; the fatality of small-pox in this (the *c*) class being only 5.6 per cent. of that in *a* (nominal) class, and not more than 28 per cent. of that in *b* (imperfect) class vaccination.

No doubt seeming inferior retention of protection at 5-10 years by the *c* class, as compared with *b* class, appears paradoxical. But it must be recollected that good class (*c*) vaccination cannot have accessions to its ranks from a better vaccinated class, seeing that (apart from revaccinated persons, which are not here considered) this, the *c* class, is the most perfectly vaccinated class. The effect, therefore, of time in producing diminution of protection against small-pox death in this class is, in all probability, truly indicated here.

3. *As to age-period* 10-14 *years.* The period of life at which the fatality of small-pox in unvaccinated persons is at its lowest.

Nominal (*a*) vaccination. The fatality of small-pox in this class at 10-14 years is practically identical with that in unvaccinated persons at the same age-period, the latter being 23.3, the former 21.3. The protective power of nominal vaccination is, therefore, at 10-14 years gone, or very nearly gone.

Here, be it observed, there is no indication of a disturbing element, such as by accessions to this class from a superior class, and it is probable enough that a longer period is required for the complete obliteration of a vaccination cicatrix than for the mere loss of foveation.

Imperfect (*b*) vaccination. The fatality of small-pox in this class at the age-period 10-14 years is 15 per cent. of that among unvaccinated patients at the same age-period. At 5-10 it was also 15 per cent.; it is therefore unaltered, there is neither loss nor gain of protection.

This state of equilibrium of class *b* at 10-14 years is, in view of almost complete loss of protection in class *a* at this age, a very striking circumstance. As has been said, there is no indication of transfer at 10-14 years to class *a* of the worst protected cases from this (*b*) class, and, accordingly, it may be inferred that class *b* owes the stability of its protection at this age to transfer to it of fairly well protected children from class *c*. Indeed, as already stated, it is conceivable that with increase of years foveation of vaccine scars may tend to disappear some considerable time before the scars themselves become obliterated.

Good (*c*) vaccination. The fatality of small-pox in this class in the age-period 10-14 years is 4.7 per cent. that among unvaccinated patients of the same age. At 5-10 years it was 4.2 per cent. There is slight loss therefore of protection with increase of age in this class. As before, however, "good" vaccination easily maintains its superiority over other vaccination, the fatality of small-pox in this (the *c*) class at 10-14 years being but 5.2 per cent. of that in class *a* (nominal) vaccination, and not more than 31.3 per cent. of that in class *b* (imperfect) vaccination.

The figures upon which the rate during 10-14 years is calculated are small, but in reference to suggestion of some loss of protective power, it may be here noted again that this class cannot receive accessions from a superior class.

4. *As to age-period* 14-20 *years*, the life-period at which the fatality of small-pox in unvaccinated patients is once more rapidly increasing.

Nominal (*a*) vaccination. The fatality of small-pox in this class at the age-period 14-20 years is 62 per cent. of that witnessed in the unvaccinated class at the same life-period. At 10-14 years it was nearly the same in both classes. The absolute increase of fatality from that at 10-14 years is therefore very much less in this than in the unvaccinated class.

Nominal (*a*) vaccination would, under these circumstances, appear to have gained protective ability between the ages 10-14 and 14-20 years, which appears out of question. It is highly probable, however, that by this time some persons whose vaccination would earlier have entitled them to rank in class *b* (imperfect) vaccination, have, after 10 years of age, so completely lost their scars that they have been reckoned with the worst vaccinated class, and that this is the reason why the latter exhibits a less fatality from small-pox.

Imperfect (*b*) vaccination. The fatality of small-pox in this class of patients in the age-period 14-20 is 15 per cent. that of the unvaccinated. At 10-14 it was also 15 per cent.; once more, therefore, there is neither loss nor gain of protection in this class.

The stability of protection in this class at 14-20 may be explained partly, as suggested above, by transfer of cases to class *a*, partly, as at 10-14, by accession of persons whose vaccination would at an earlier period have entitled them to rank in class *c* (good vaccination), but whose vaccination scars have since lost their foveation.

Good (*c*) vaccination. The fatality of small-pox in this class of patients in the age-period 14-20 years is 6.1 per cent. of unvaccinated persons at the same life-period. At 10-14 it was 4.7. There is here, therefore, evidence of loss of protective power in this class, and the loss is parallel to that observed in the unvaccinated class, as was to be expected. Nevertheless, at 14-20 years, "good" vaccination retains a marked superiority to all other vaccination; the fatality in this (the *c*) class being but 9.8 per cent. of that in class *a* (nominal) vaccination, and not 41 per cent. of that in class *b* (imperfect) vaccination.

The chief facts thus far may now be summarised.

1. Liability to death from small-pox of persons aged twenty and under, suffering attack is, in the vaccinated and in the unvaccinated respectively, influenced by the age of the patient at date of attack.

2. Among unvaccinated small-pox patients more especially, liability to death is influenced by the condition of age. Among them it is at its maximum in the first five years of life; at its minimum at ten to fifteen years of age; and after fifteen it somewhat rapidly increases again.

3. Among vaccinated small-pox patients liability to death, though influenced to some extent by age, is in the main governed by the character of the vaccination possessed by the individual patient, as evidenced by his vaccine scars at the date of his attack. Thus:—

> *a*. Small-pox patients having "nominal" vaccination at the date of their attack, die, according to their age, from $\frac{6}{10}$ to $\frac{9}{10}$ the extent of unvaccinated patients at corresponding ages. Such influence as the miscellaneous vaccination and no vaccination of this class may possess is most conspicuous at the extremes of the ages under review, viz., 0-5 and 14-20. Between 10 and 14 the fatality of small-pox attack in this class is practically identical with that in the unvaccinated class of corresponding ages.
>
> *β*. Small-pox patients having "imperfect" vaccination at the date of their attack, die, according to their age, from $\frac{5}{35}$ to $\frac{7}{35}$ the extent of unvaccinated patients at corresponding ages. They have received a part only of the protection that vaccination can give; and its protective influence, instead of being conspicuous in early life (when children are especially prone to die if attacked by small-pox, and when, therefore, the fullest protective

that vaccination can give, is most urgently called for), is most discernible after the age of five years.

γ. Small-pox patients having "good" vaccination at the date of their attack, die, according to their age, from $\frac{2}{80}$ to $\frac{5}{80}$ only the extent of unvaccinated patients at corresponding ages. The distinction between the two is most marked in the case of those ages when, in the absence of vaccination, the liability to death is greatest, namely under five years of life. The absolute probability of fatal ending lessens further, indeed, if the attack be deferred till age has advanced to 10-14 years, for in vaccinated people, as well as unvaccinated, the postponement of attack to this period is found to help toward recovery; and the liability to a fatal termination is, further, in a measure regained (again as in the case of the unvaccinated) as the age of twenty is approached.

There can be no doubt whatever, then, that as a protection against death by small-pox "good" vaccination,—*i.e.*, vaccination producing persistent well foveated scars,— is upon all counts pre-eminent. The next question is, what is the "best" vaccination ?

Herein is involved consideration of *quantity* as well as quality of vaccination ; and accordingly examination has been made for the period of life (0-20 years) under consideration of the fatality of small-pox as it has affected persons possessing, at the date of their attack, one, two, three or more scars each, on the one hand of "good" and on the other of "imperfect" vaccination. The process of division and subdivision thus entered on of the cases reported to us, has in certain instances resulted in somewhat paltry figures as bases of calculation, so that inferences, therefore, have to be drawn with caution. Nevertheless, the Committee has decided to present the results of these subdivisions of the cases, believing that some general indications thence arising are sufficiently definite to have a distinct value of their own. This has, therefore, been done in Tables II(*a*) and II(*b*).

Table II(*a*) *shows for persons possessing "imperfect" and for persons possessing "good" vaccination at date of attack in each of the age-periods previously dealt with, the percentage of fatality of small-pox, according as the patient presented one, two, or three or more scars. As before, for purposes of comparison, the rate of fatality of small-pox in unvaccinated persons at the several age-periods is given in a separate column.*

TABLE II(*a*).

Age-period, Years.	Unvaccinated.	Age-period, Years.	Vaccinated.					
			One Scar.		Two Scars.		Three or more Scars.	
			b Class. Imperf. Vacc.	*c* Class. Good Vacc.	*b* Class. Imperf. Vacc.	*c* Class. Good Vacc.	*b* Class. Imperf. Vacc.	*c* Class. Good Vacc.
0– 5	56.5	0– 5	21.9	0.0	13.3	0.0	5.2	2.0
5–10	35.2	5–10	6.7	1.8	7.6	3.3	3.1	0.9
10–15	23.3	10–14	6.9	2.8	5.2	0.7	0.9	0.7
15–20	42.1	14–20	10.4	3.4	6.0	1.7	4.1	2.8

Table II(*b*) *gives the proportional fatality of small-pox attacks at the several ages in the two classes of vaccinated persons, and, in their subdivisions, the fatality of small-pox at each age in unvaccinated patients being represented by* 100.

TABLE II(*b*).

Age-period, Years.	Unvaccinated.	Age-period, Years.	Vaccinated.					
			One Scar.		Two Scars.		Three or more Scars.	
			b Class. Imperf. Vacc.	*c* Class. Good Vacc.	*b* Class. Imperf. Vacc.	*c* Class. Good Vacc.	*b* Class. Imperf. Vacc.	*c* Class. Good Vacc.
0– 5	100	0– 5	39	0	23	0	9	3
5–10	100	5–10	19	5	21	9	9	2
10–15	100	10–14	30	12	22	3	4	3
15–20	100	14–20	25	8	14	4	9	6

The most conspicuous outcome of these tables is further demonstration of the fact of the immense superiority of "good" (*i.e.*, foveated) over "imperfect" (*i.e.*, unfoveated) vaccination, and a tolerably strong indication that *quantity,—i.e.*, number of scars—is an important element in the amount of protection against death by small-pox afforded by a given quality of vaccination.

As to this further illustration of the superiority of foveated vaccination, it is enough to note that in no single instance of the dozen contrasts in the tables between "good" and "imperfect" vaccination is the protection against death afforded by "imperfect" vaccination to be for a moment compared with that resulting from "good" vaccination. This is the more remarkable, since the figures whereon the rates have been in some instances based are small figures, and the uniformity, therefore, of their testimony exceptionally liable to disturbance.

As regards, however, the indication of quantity of scar as an element of the protection afforded by a given vaccination, the evidence, so far as it goes, is less uniform in its tendency. Concerning "imperfect" vaccination there is indication that multiple scars are associated with a higher degree of protection than are single scars, but as regards "good" vaccination, there is less evidence of this. For the period of life (0-20 years) under investigation a single foveated scar appears indeed as protective as multiple unfoveated scars, but multiple foveated scars do not appear to possess the protective advantage over single foveated scars that multiple unfoveated scars have over single unfoveated scars. This indication, namely, of no great difference of protective value between one and many scars in "good" vaccination, is a somewhat surprising one; and we have hesitated in accepting it as valid until some other data that had been furnished us, and which seemed to promise light on the subject, had been duly examined.

In this connection it deserves notice, that if there be such a thing as transference from class *c* to class *b*, owing to obliteration through time and circumstance of the foveation of scars, it may very well have operated here in giving a fictitious appearance of value to "imperfect" vaccination. In these tables, as in Tables I(*a*) and I(*b*), anomalous improvement at certain ages of the protection afforded by "imperfect" vaccination might in this way be explained; as, for instance, the improvement as regards protection indicated of "one" and "two" scars in class *b* at ages 5-10 and 14-20. Similarly, the comparatively small difference of protective value between classes *c* and *b*, of three or more scars, might be thus accounted for.

The other data referred to possess the advantage of dealing with *severity of attack* instead of fatality of small-pox. Where children—to whom even imperfect vaccination is for a few years subsequent to the operation a very considerable protection against death by small-pox—are concerned, this may be no small gain. For liability to severe attack is likely to be a condition antecedent to increased liability to death by small-pox; and measure, therefore, of liability to severe attack may be thought of as a more delicate test of the protective value of a given sort of vaccination than any comparison of rates of fatality can be. In the present instance the data in question are not so abundant as could be wished, and they do not extend to persons over ten years of age; moreover, in the absence of material for the purpose they cannot be compared with similar data from the unvaccinated class. Nevertheless we give, in Tables III(*a*) and III(*b*), the figures prepared by us from the sources at our disposal, believing them to be of value as indications of the truth ; and we use for a standard of comparison severity of attack in children only "nominally" vaccinated.

Table III(*a*) *shows for persons possessing "imperfect" and for persons possessing "good" vaccination at dates of attack, in several age-periods, the percentage of severe attacks, according as the patients presented one, two, or three or more vaccine scars (discrete and semi-confluent small-pox being regarded as mild, other forms as severe).*

TABLE III(*a*).

Age-period.	*a* Class. Nominal Vacc.	One Scar.		Two Scars.		Three or more Scars.	
		b Class. Imperf. Vacc.	*c* Class. Good Vacc.	*b* Class. Imperf. Vacc.	*c* Class. Good Vacc.	*b* Class. Imperf. Vacc.	*c* Class. Good Vacc.
0- 5	34·1	19.5	0	15.5	0	9.3	0*
5-10	38·1	18.1	5.3	12.1	6.6	5.0	2.3

Table III(*b*) *gives the proportional severe cases of small-pox at the several ages in the two classes and in their subdivisions, the severity of small-pox attack at each age in "nominally" vaccinated patients being represented by* 100.

TABLE III(*b*).

Age-period.	*a* Class. Nominal Vacc.	One Scar.		Two Scars.		Three or more Scars.	
		b Class. Imperf. Vacc.	*c* Class. Good Vacc.	*b* Class. Imperf. Vacc.	*c* Class. Good Vacc.	*b* Class. Imperf. Vacc.	*c* Class. Good Vacc.
0- 5	100	57	0	45	0	27	0*
5-10	100	47	14	32	17	13	6

The indications of these tables are of a sort to heighten regret that a proper standard from the unvaccinated class is not available, wherewith to compare the figures ; and strongly to suggest that liability to severe attack is, indeed, in childhood a more delicate test than liability to death, of the value of one and another kind of vaccination. Briefly, the indications seem to be these:—

In the first five years of life, when the conflict between liability to death by small-pox and protective influence of recent infantile vaccination is keenest, the quality of *fovea-*

---

* It should be observed that the fatality of persons from 0-5 years with three or more "good" scars, shown in Tables II(*a*) and (*b*), is due to one death, that of a child who died after an attack of "discrete" small-pox.

tion in scars is obviously all-important in preserving the vaccinated child from severe attack of small-pox. And next to foveation at 0-5 comes quantity, *i.e.*, multiplicity of scars; for at this age three or more " imperfect" scars appear vastly more protective against severe attack than only one, or even two, such scars. As to the second five years of life (5-10), when liability to death by small-pox is waning, and when the protective influence of a more remote primary vaccination is also on the wane, the matter is, of course, more complex. It was at this age that in antecedent tables of this report there was recognised the beginning of a tendency for children to become transferred, by loss of foveation of their scars, from the highest to a lower class, and with the result that "imperfect" scars could at 5-10 appear even more protective against death by small-pox than at 0-5 years. So too, apparently, from Tables III(*a*) and III(*b*), with the protection afforded by " imperfect" scars against *severe attack* of the disease. But however this may be, the sort of vaccination which at 5-10 appears beyond all others protective against severe small-pox is that which presents at the date of attack well foveated scars, and " three *or more*" of them. Thus the proportion of severe attacks at this age in children possessing three or more foveated scars is not more than 46 per cent , that of children possessing a like number of unfoveated scars is only 19 per cent. that of children possessing two unfoveated scars, and is but 12.7 per cent. that of children possessing single unfoveated scars.

In reference to *number* of scars as influencing endurance of protection, the Committee regret again the circumstance that the data furnished them could not be dealt with after the fashion of Mr. Marson's statistics, which allowed comparison of protective value associated with one, two, three, and *four or more* scars. There might, the Committee believe, have been profit in comparing the protective value of three with that of four or more scars, for they are disposed to regard *number* and *quantity of area* of scars as by no means convertible terms.

RE-VACCINATION AND SMALL-POX.

Questions III and IV.

In addition to certain facts bearing, as just now recorded, in reference to primary vaccination, on severity of small-pox attacks, the Committee have been furnished, in regard of re-vaccinated persons, with some tolerably abundant data respecting their susceptibility to small-pox when exposed day by day to infection by attendance on small-pox patients. As regards persons employed in this fashion, the facts about

1,500 individuals are reported on. They include a few who had had small-pox, and a few also who had been *once* vaccinated only, before entering on their duties; but in the main they were *twice* vaccinated persons, *i.e.*, individuals who having been vaccinated in infancy, were again vaccinated —that is, *re-vaccinated*—just before commencing to attend upon small-pox. Of the total 1,500 thus exposed to infection, only 43 (less than three per cent.) contracted small-pox, and not one of these 43 had been re-vaccinated. In particular illustration of the immunity from small-pox of re-vaccinated persons subjected to close and sustained relation with the disease, the Committee may cite the experience of the Metropolitan Asylums Board. Complete information as to 734 nurses and attendants at the Board's small-pox hospitals are reported to us by Drs. Collie, MacCombie, and Sweeting, and they show that all re-vaccinated nurses and attendants are absolutely protected against attack by small-pox; whereas *once* vaccinated persons, *i.e.*, adult nurses and attendants who by accident or oversight get left with a remote infantile vaccination as their only protection, are apt at some time or other of their hospital service, to become attacked by small-pox The 734 cases reported on divide into :—

> 79 persons who had suffered small-pox before taking service at hospital; *not one* of whom again contracted small-pox.
>
> 645 persons not only vaccinated in infancy, but re-vaccinated also just before entering on their duties at hospital; *not one* of whom subsequently took small-pox.
>
> And 10 persons vaccinated in infancy, but who *had not been re-vaccinated* before entering on duty at hospital; *every one* of whom contracted small-pox at some period or other of their service.

Further information of the same kind is given by Dr. Gayton concerning 620 attendants, but the fact is not recorded as to the number of these who had previously suffered from small-pox; all but three, however, had been re-vaccinated, and only these three suffered from small-pox after commencing their duties.

As regards severity of small-pox attack in re-vaccinated persons who do contrive somehow or other to contract small-pox, there is not much to be said. Numerically, this class is a very small one, as indeed may be inferred from the hospital experience above recorded; and notwithstanding all diligence of inquiry for small-pox among re-vaccinated persons, only

69 such cases could be heard of. This number is not greatly in excess of the number of persons reported to the Committee as having suffered from a second attack of small-pox,* and it is too insignificant to permit of any but the broadest possible classification of the cases. But it happens that in 61† of these cases information is given which renders them nearly equally divisible into persons presenting at the date of their attack by small-pox cicatricial evidence of their re-vaccination, and persons, nominally re-vaccinated, whose bodies did not, at the date of their small-pox, furnish any such confirmatory evidence of their re-vaccination. Also it happens, as regards both divisions, that the average interval between occasion of re-vaccination and subsequent attack of small-pox was about ten years.

In view, therefore, of the facts recorded in this report as to the incidence of severe small-pox attack upon *once* vaccinated persons, the different behaviour of small-pox in these two classes of re-vaccinated persons is worth noting. Of 36 re-vaccinated people, who at the date of their attack by small-pox retained scars of their re-vaccination, less than 12 per cent. suffered from the disease in its severer forms; whereas of 25 re-vaccinated persons, who at date of their small-pox presented no cicatricial evidence of having undergone the operation, above 20 per cent. suffered severely from the disease. The facts are no doubt too few for secure basis of inference; nevertheless they seem suggestive, that as with primary vaccination so with revaccination, obliteration of scar is correlated with considerable diminution of the protection against small-pox conferred by the operation.

INSUSCEPTIBILITY TO VACCINATION.

The replies to Question VI cannot be regarded as very satisfactory. In but few cases has information been given as to the total number of persons vaccinated by those gentlemen who stated that they had met with one or two cases of insusceptibility. So far as they go, especially the cases of Drs. Harthill and Vertue, they tend to confirm a belief of the Committee, that it is very doubtful whether such a condition as insusceptibility really exists, except, perhaps, under the circumstances mentioned in reply to Question VII. They may add the experience of one of their number (Dr. Cory), who in the vaccination of over 30,000 children not previously vaccinated, did not find a single case of insusceptibility.

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* *Small-pox after a previous attack of small-pox.*—Answers to question V illustrate the fact that people can suffer from a second attack of small-pox, some sixty or more such cases having been communicated to the Committee. A third attack is, indeed, reported in three cases, and in two of them it proved fatal.

† In eight cases no information is given as to whether there was cicatricial evidence of secondary vaccination at time of attack by small-pox.

SUSCEPTIBILITY TO VACCINATION OF BABIES WHOSE MOTHERS SUFFERED FROM SMALL-POX WHEN PREGNANT WITH THEM.

In reply to Question VII twelve cases are reported, in which the vaccination of babies was attempted, whose mothers, when pregnant with them, suffered from small-pox. In only six of them was note made of the period of pregnancy at which the mother suffered from the disease. In two of the six (communicated by Mr. W. M. Burman), wherein small-pox appeared one and four days respectively before labour, the subsequent vaccination of the babies ran a normal course. Their ages at the time of vaccination are not known. As regard other two of the six (under Mr. J. P. Wilton's observation), the first was born about the fourth week of the mother's small-pox; in the second the exact date of the small-pox cannot be fixed, but Mr. Wilton writes that if his memory serves him correctly, the small-pox occurred somewhat earlier in the pregnancy than in his other case. However this may have been, in both these cases, vaccination of the babies was attempted at least three times during the first eighteen months of life, and failed of success. These four cases tend to indicate, that small-pox attacking a mother during the last few days of her pregnancy, does not affect the fœtus so as to render the baby subsequent to birth insusceptible to vaccination; but that small-pox occurring in the mother at an earlier period of pregnancy does seem to have some such influence. In this connection, two other cases, communicated by Mr. Sweeting, have special interest. In the first the child was born seventeen days later than the date of commencement of the mother's small-pox attack, and vaccination of it immediately after birth proved unsuccessful. In the second the baby was born eight days after commencement of the mother's attack, and in this case the vaccination, which, also, was done immediately after birth, was successful. A third case was reported by Mr. Sweeting, in which the baby was born two days after the mother was attacked. It was admitted into the small-pox hospital when twelve days old, and on admission vaccination was forthwith attempted. Two days later, however, the child died from inanition, and at its death there was no evidence of the vaccination being about to prove successful. The speedy death of this child after admission to hospital, of course deprives the case of any value in the way of evidence on the point at issue.

APPENDIX.

TABLE I.

Unvaccinated.		Vaccinated.									
			Nominal.			Imperfect.			Good.		
Age-period.	Mort. per cent.	Age-period.	Cases.	Deaths	Mort. per cent.	Cases.	Deaths	Mort. per cent.	Cases.	Deaths	Mort. per cent.
0– 5	56.5	0– 5	82	30	36 6	182	20	11.0	68	1	1.5
5–10	35.2	5–10	165	44	26.6	768	40	5.2	329	5	1.5
10–15	23.3	10–14	164	35	21.3	1056	37	3 5	530	6	1.1
15–20	42.3	14–20	239	63	26.3	2478	157	6.3	1602	42	2.6

TABLE II.

Unvaccinated.					One Scar.						Two Scars.						Three or more Scars.					
					Imperf. Vacc.			Good Vacc.			Imperf. Vacc.			Good Vacc.			Imperf. Vacc.			Good Vacc.		
Age-period.	Cases.	Deaths.	Mort. per cent.	Age-period.	Cases.	Deaths.	Mort. per cent.	Cases.	Deaths.	Mort. per cent.	Cases.	Deaths.	Mort. per cent.	Cases.	Deaths.	Mort. per cent.	Cases.	Deaths.	Mort. per cent.	Cases.	Deaths.	Mort. per cent.
0– 5	677	383	56.5	0– 5	41	9	21.9	6	0	0.0	45	6	13.3	11	0	0.0	96	5	5.2	51	1	2.0
5–10	510	180	35.2	5–10	193	13	6.7	56	1	1.8	197	15	7.6	60	2	3.3	378	12	3.1	213	2	0.9
10–15	317	74	23.3	10–14	244	17	6.9	105	3	2.8	289	15	5.2	148	1	0.7	523	5	0.9	277	2	0.7
15–20	204	86	42.1	14–20	625	65	10.4	346	12	3.4	828	50	6.0	524	9	1.7	1025	42	4.1	732	21	2.8

TABLE III.

Age-period.	Class *a.* Nominal Vacc.			One Scar.						Two Scars.						Three or more Scars.					
				Class *b.* Imperf. Vacc.			Class *c.* Good Vacc.			Class *b.* Imperf. Vacc.			Class *c.* Good Vacc.			Class *b.* Imperf. Vacc.			Class *c.* Good Vacc.		
	Cases.	Severe Cases.	Per cent. Severe Cases.	Cases.	Severe Cases.	Per cent. Severe Cases.	Cases.	Severe Cases.	Per cent Severe Cases.	Cases.	Severe Cases.	Per cent. Severe Cases.	Cases.	Severe Cases.	Per cent. Severe Cases.	Cases.	Severe Cases.	Per cent. Severe Cases	Cases.	Severe Cases.	Per cent. Severe Cases.
0– 5	82	28	34.1	41	8	19.5	6	0	0.0	45	7	15.5	11	0	0.0	96	9	9.3	51	0	0.0
5–10	165	63	38.1	193	35	18.1	56	3	5.3	197	24	12.1	60	4	6.6	378	19	5.0	213	5	2.3

III.—What cases of small-pox after re-vaccination have come under your observation?

In answering this question, please state, as far as possible :—

(*a*) The number and character of the primary vaccination cicatrices.

(*b*) The age of the patient at the time of secondary vaccination, the number and character of the resulting cicatrices. If none remain, please state the fact, as well as any fact as to the maturity of the vesicles or intensity of the inflammation.

(*c*) The character of the attack of small-pox, and the result.

(*d*) The age of the patient at the time of the attack of small-pox.

(*e*) The sex of the patient.

MALES.

No. of case	Age.	No. and character of primary scars.	No. and character of secondary scars.	Age of patient at time of re-vaccination	Character of small-pox.	Recovered.	Died.
1	26	none visible	4 poor	16 years	Discreta	R.	...
2	20	none visible	2 poor	10 years	Discreta	R.	...
3	26	2 fair	3 poor	19 years	Discreta	R.	...
4	26	5 fair	4 poor	21 years	Discreta	R.	...
5	23	6 poor	none visible	15 years	Semi-confluens	R.	...
6	25	4 fair	2 poor	13 years	Semi-confluens	R.	...
7	25	2 fair	none visible	19 years	Semi-confluens	R.	...
8	22	2 poor	none visible	15 years	Varicelloid	R.	...
9	21	3 fair	none visible	16 years ?	Discreta	R.	...
10	26	5 poor	none visible	16 years	Discreta	R.	...
11	29	8 poor	doubtful if any secondary	12 years	Confluens	R.	...
12	20	3 poor	none visible	16 years	Varicelloid	R.	...
13	18	2 fair	2 poor	16 years	Discreta	R.	...
14	28	3 poor	none visible	16 years	Semi-confluens	R.	...
15	44	4 poor	none visible	doubtful supposed many years ago	Semi-confluens	R.	...
16	41	3 poor	none visible	11 years	Discreta	R.	...
17	28	2 fair	none visible	25 years	Semi-confluens	R.	...
18	37	4 poor	none visible	20 years	Confluens	R.	...
19	17	2 good	2 small	8 years	Discreta	R.	...
20	19	none visible	1 good	5 or 6 yrs.	Discreta	R.	...
21	29	1 poor	3 faint	24 years	Discreta	R.	...
22	51	faint	faint	37 years	Discreta	R.	...
23	27	3 faint	3 distinct	10 years	Discreta	R.	...
24	33	1 poor	1 poor	17 years	Discreta	R.	...
25	45	2 poor	1 poor	35 years	Discreta	...	D.
26	38	none visible	2 poor	15 years	Hæmorrhagica	...	D.
27	23	1	1	15 years	Discreta	R.	...
28	27	good	arm sore in three days	17 years	Discreta	R.	...
			scab about the size of sixpence, arm red and hard, not sure whether it took	22 years			
29	44	1 faint	none visible	34 years	Discreta	R.	...
30	24	imperfect	none visible, had sore arm	21 years	Discreta	R.	...
31	19	3 poor	2 poor	16 years	Discreta	R.	...
32	27	1 good	none visible, had sore arm	15 years	Discreta	R.	...
33	19	8 poor	not stated	12 years	Discreta	R.	...
34	30	3 fair	not stated	8 years	Discreta	R.	...
35	17	2 poor	3 good	not stated	Semi-confluens	R.	...
36	14	5 good	4	not stated	Discreta	R.	...
37	17	4 good	2 good	15 years	Discreta	R.	...
38	20	1	not stated	19$\frac{9}{12}$ years	Discreta	R.	...
39	11	3	not stated	10 years	Confluens	R.	...
40	18	1	not stated	14 years	Confluens	R.	...
41	4 years after puberty.	1	not stated	Puberty	Confluens	R.	...

FEMALES.

No of case.	Age.	No. and character of primary scars.	No. and character of secondary scars.	Age of patient at time of re-vaccination	Character of small-pox.	Recovered.	Died.
1	29	9 fair	3 good	not stated	Discreta	R.	...
2	31	3 poor	none visible	9 years	Corymbosa	...	D.
3	23	4 poor	1 poor	13 years	Hæmorrhagica	...	D.
4	33	3 poor	none visible	doubtful	Discreta	R.	...
5	38	4 poor	none visible	38 years ?	Semi-confluens	R.	.
6	56	2 poor	none visible	13 years	Confluens	R.	...
7	35	2 poor	none visible	19 years	Semi confluens	R.	...
8	25	3 poor	none visible	22 years	Confluens	R.	...
9	39	none visible	1 faint	7 years	Discreta	R.	...
10	31	2 poor	none visible no result no result	14 years 21 years 27 years	Discreta	R.	...
11	26	1 good	1 poor	14 years	Discreta	R.	..
12	44	2 imperfect calf lymph	2 imperfect	35 years	Discreta	R.	...
13	29	3 imperfect	3	19 years	Hæmorrhagica	...	D.
14	20	2 poor	3	16 years	Discreta	R.	...
15	23	5 poor	none visible, had sore arm on both occasions	10 years 16 years	Discreta	R.	...
16	21	2 good	4	9 or 10 yrs.	Discreta	R.	...
17	42	2 imperfect	1	12 years	Discreta	R.	...
18	36	3 imperfect	3	16 years	Confluens	R.	..
19	33	1 imperfect	none visible, stated had sore arm	21 years	Maligna	...	D.
20	21	none visible	3	18 years	Discreta	R.	...
21	36	3 imperfect	2	31 years	Discreta	R.	...
22	20	2 good	not stated	19 years	Discreta	R.	...
23	16	3 fair	2	11 years	Discreta	R.	...
24	19	2 good	none visible	11 years	Discreta	R.	.
25	20	5 poor	3	not stated	Discreta	R.	...
26	26	6 poor	3	not stated	Discreta	R.	...
27	36	1 poor	4 fair	31 years	Discreta	R.	...
28	19	3 good	2 indifferent	18 years	Discreta	R.	...

IV.—(*a*) How many persons have you known to be in personal attendance on cases of small-pox?
(*b*) How many of these had previously had small-pox?
(*c*) How many of them (*a*) had contracted small-pox?
(*d*) How many of those who did not contract small-pox were revaccinated?
(*e*) How many of those who contracted small-pox were revaccinated?
Of the last, state the character of, and date of, vaccination; the date, character, and result of attack of small-pox.
V.—How many cases of small-pox have come under your observation in which the patient had previously suffered from this disease?
VI.—Have you ever met with a case of insusceptibility to primary vaccination, and if so, how many?
VII.—Have you ever vaccinated any child whose mother suffered from small-pox while pregnant with it, and if so, with what results?

	IV. (*a*)	IV. (*b*)	IV.(*c*)	IV. (*d*)	IV. (*e*)	V.	VI.	VII.
M. A. Adams, F.R.C.S., Maidstone	10	2	0	4	0	0	0	0
W. M. Burman, L.R.C.P., M.R.C.S., Wath, near Rotherham	56	3	11	about 36	0	0	0	2
D. Campbell, M.D., Calne, Wilts...	...	...	...	...	...	0	0	0
W. J. Candler, M.R.C.S., Harleston	about 12	0	0	about 6	...	0	2 or 3	0
F. de B. Collenette, M.R.C.S., Chesterton	0	...	...	...	...	0	about 6	0
B. N. Dalton, M.D., South Norwood	3	0	0	3	...	0	0	0
G. Foote, M.R.C.S., Kingston	average, 3 to each case.	1	0	several	0	0	0	0
J. H. Freer, L.R.C.P., Rugeley ...	...	...	...	...	...	...	2	0
H. Grace, L.R.C.P., Bristol	...	...	...	...	...	a few, one had it three times and died	...	...
J. H. Gramshaw, M.D., Gravesend	3	0	0	3	...	...	...	...
J. Gregory, L.R.C.P.Ed., Manchester	7	0	0	7	...	0	0	0
W.C. Grigg, M.D., Curzon Street, W.	...	...	...	...	...	1	2 adults 2 infants	1 ...
J. T. Harthill, L.R.C.P., Willenhall	6	doubtful	...	...	...	0	none in 8,000	1
J. S. Holden, M.D., Sudbury	about 30	7	9	6	0	0	0	0
D. Mackinder, M.D., Gainsborough	many	cannot say	0	all	...	2 or 3, 1 died of third attack	have met with some, cannot state how many	0
C. Meeres, M.R.C.S., Sandown ...	a great many	no record	0	all	...	4, 1 third attack	0	0
A. Ransome, M.D., Manchester ...	...	...	...	...	...	...	2	...
T. H. Redwood, M.D., Rhymney...	...	...	...	...	...	2	1 child vac. 3 times	...
J. Shea, M.D., Reading..............	14	2	6	6	0	...	...	...
H. Thomson, M.D., Glasgow	no record	...	0	a good many	...	0	2 in 12,000	0
F. H. Vertue, M.R.C.S., Southwold	very few	0	0	no record	...	0	0 in 3,000	0
J. W. Burdwood, L.F.P.S., Bourne	14	0	2	0	0	0	0	0
J. P. Wilton, M.R.C.S., Gloucester	...	...	...	...	...	4	2	2
W. Few, M.R.C.S., Ramsey	3	0	2	...	...	...	...	...
J. MacCombie, M.D., Deptford ...	265	65	2	198	0	30	1	3
R. D. R. Sweeting, M.R.C.S., Fulham	69 1	6	0	63 1	0	2	0	3
H. E. Armstrong, M.R.C.S., Newcastle	5	0	0	5	...	9	0	0
W. J. Collins, M.D., Albert Terrace, N.W.	5	0	0	1	...	1	0	0
W. Gayton, M.D., Hampstead......	620	not stated	3	all	0	...	...	...
A. Collie, M.D., Homerton	400	8	8		0	...	...	...

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